THE NET ECONOMIC VALUE OF ELK HUNTING IN MONTANA

Montana Department of Fish, Wildlife & Parks

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EXECUTIVE SUMMARY

The objective of this study was to estimate the net economic value (net willingness to pay) of elk hunters in Montana for the 1985 hunting season. A regional travel cost model (TCM) was used to statistically estimate an elk hunting demand equation from survey data.

The regional TCM approach is recommended by the U.S. Water Resources Council as one of the two preferred techniques for estimating recreational benefits. In addition, a number of federal agencies are required by the Water Resource Council Principles and Guidelines to use the concept of net economic value when evaluating federal agency actions.

The TCM method uses the distance traveled as a measure of price and the number of trips taken from a given origin to a particular site as a measure of quantity. The resulting demand equation is used to calculate the additional amount hunters would be willing to pay, over and above their travel costs, to have the opportunity to hunt at the site in question.

The survey data utilized by this study is based on a telephone survey of licensed hunters undertaken by Montana Department of Fish, Wildlife and Parks (DFWP) in January and February of 1986.

Hunters were asked sites visited, species hunted, travel distance, travel expenditures and hunter demographics such as age, income and years hunted. A total of 696 telephone interviews were completed with elk hunters. The 129 elk hunting districts defined in the DFWP hunting regulations were aggregated into 22 specific hunting sites for purposes of this study.

The conversion of distance traveled to a dollar value (travel cost) is accomplished by multiplying travel distance by the reported cost of 42.2 cents per mile. The latter includes both variable out of pocket expenditures per mile and the opportunity cost of travel time. The variable cost of travel of 34.6 cents per mile was derived from regression analysis of hunter reported trip expenditures. The opportunity cost of travel time was based on one-third of the hunter sample hourly wage rate (following Water Resource Council guidelines).

In 1985 there was a 17,000 quota on non-resident Montana combination hunting licenses. This creates a special problem for the TCM method in that a random sample of license holders does not reflect the actual total demand by out of state hunters. A model was developed to predict the number of nonresident elk permits that could have been sold in 1985 in the absence of the quota. Time series data including permits sold and price for 1970 to 1978 (years prior to an effective quota constraint) were utilized. The estimated model predicts that in 1985

approximately 30,000 non-resident licenses could have been sold at then current price of $300.

The TCM demand curve was estimated both on the random sample of licensed hunters and on a corrected sample (including the higher proportion of nonresident hunters that would be observed in the absence of a license quota). The estimated models provided a good fit to the data, with hunting trips per capita a function of distance (travel cost), years hunted and success rates for bull elk at the site hunted. Because the model overpredicts total trips, benefit estimates were based on actual trips taken.

For the random sample of licensed hunters, the state average net economic value for elk hunting is $185 per trip. This means a hunter would be willing to pay $185 more per trip (on average) to have the opportunity to elk hunt a given area. On a per day basis (based on an average of 2.8 days per trip), the net economic value for elk hunting is $66. Utilizing the sample average of 6.3 hours of hunting per day, the U.S. Forest Service 12 hour recreational visitor day (RVD) for Montana elk hunting is $125.

The annual aggregate value of Montana's elk hunting areas is $38 million. This is calculated by multiplying the value per day times the DFWP elk hunting pressure estimate for 1985 of 572,000 hunter days.

The study includes an analysis of the sensitivity of benefit estimates to methodological choices. For example, use of predicted trips in the benefit calculation (rather than actual observed trips) results in net economic values about 65 percent higher than those summarized above. Interestingly, correcting the sample to reflect the full non-resident demand had little effect on net economic values (5 to 8 percent higher than those summarized above).

Study results are also compared to estimates for three other recent elk hunting studies in the Northern Rockies. The most similar study (a TCM model for Idaho) estimated values that are approximately one-half as high as those derived here for Montana.

A secondary objective of this study was to provide data on hunter expenditures. Average expenditure for a Montana elk hunting trip in 1985 was $285. There was a large difference between average resident expenditures ($81) and nonresident expenditures ($1399). Over half of resident expenditures was on transportation, with most of the remainder being for food purchased in stores. Fifty percent of nonresident expenditures were for guiding fees with the remainder evenly split between transportation expenses and food and lodging expenses. It is interesting to note that nonresident trips average 2900 roundtrip miles while residents travel an average of 194 miles. Total estimated expenditure for

Montana elk hunting in 1985 is $58 million.

The net economic values presented in this paper are the appropriate values to use in benefit/cost analysis or where economic efficiency decisions (i.e., forest or range planning) are being made. If the annual values of elk hunting are put into net present value, they can be used in trade-off analysis with marketed resources, such as timber, coal or grazing. The net economic values presented here are limited to the direct use values associated with Montana elk hunting resources. Accordingly, these net economic values are an underestimate of the total value associated with this resource, since indirect values (existence, bequest and option uses) have not been estimated.

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The authors would like to thank Rob Brooks for his excellent data management effort. John Cada also provided us with some of the data utilized in this study. We would like to thank Pat Graham for his persistance in making his vision of this study come to life. We would also like to thank Stewart Allen for his work on designing the survey. John Loomis also participated in the survey design and contributed his background in recreation analysis to the formulation of the study methodology.

I. INTRODUCTION

A) PURPOSE AND SCOPE OF RESEARCH

The main objective of this research is to statistically estimate the net economic value (net willingness to pay) for elk hunting in Montana using a survey of Montana hunters. The hunting benefit estimates are derived from a regional (multi-site) travel cost model (TCM) demand equation. These estimates should prove useful in policy and planning decisions, including U.S. Forest Service and Bureau of Land Management multiple-use planning decisions. A secondary objective is to collect data on resident and nonresident hunter expenditures.

The scope of this study is limited to an analysis of direct hunting use. Accordingly, this study does not quantify the total net economic value of elk hunting resources in Montana. Many people besides current hunters derive economic benefits from knowing Montana's wildlife and associated wildlife habitats exist (i.e., existence value) or knowing that these resources exist for future generations (i.e., bequest value). In addition, individuals who currently do not hunt may be willing to pay to maintain the opportunity to hunt in Montana in the future (i.e., option value). The total net economic value of elk hunting includes these indirect or intrinsic values as well as the direct

use values estimated by this study.

B) DEFINITION OF BENEFITS

Many federal agencies are required by the U.S. Water Resources Council Principles and Guidelines (1983) to use net willingness to pay (net economic value) as a measure of value in benefit cost analysis or evaluation of federal actions. When preforming natural resource damage assessments, U.S. Department of Interior regulations require the calculation of economic values lost to society be measured in terms of net willingness to pay (U.S. Department of Interior, 1986). Use of net willingness to pay is also recommended in textbooks on benefit cost analysis (Sassone and Schaffer, 1978; Just, Hueth and Schmitz (1982)).

II. RECREATION DEMAND AND BENEFIT ESTIMATION METHODOLOGY

A) INTRODUCTION

The method employed in this study is a regional travel cost model. This approach is recommended by the U.S. Water Resources Council (1979, 1983) as one of the two preferred techniques for estimating recreation benefits. The method is one of the most widely applied demand estimating techniques. TCM uses observations of travel distance as a measure of price and trips taken as a measure of quantity to statistically trace out a demand equation. The resulting first stage or per capita demand

equation allows the analyst to calculate the additional amount the recreationists would pay over and above their travel costs to have access to a site for hunting. This calculation can be done using a "second stage" or site demand curve that relates added distance or added travel cost to visitation. The method used here is direct integration of the first stage demand curve, which is an equivalent approach (Menz and Wilton, 1983). See Clawson and Knetsch (1966), Dwyer, Kelly and Bowes (1977) or Sorg and Loomis (1985) for a discussion of the basic TCM approach.

B) ESTIMATING THE FIRST STAGE OR PER CAPITA DEMAND EQUATION

The traditional TCM demand equation has as its dependent variable, trips per capita from a given zone (for example, a county or state) of origin to a particular site. An alternative approach is the individual observations model (Brown and Nawas, 1973). In the latter the dependent variable is the sum of trips that a given individual makes to a site over the course of a recreation season. It has been shown that the latter method will generally lead to overestimates of consumer surplus (Brown et al, 1983). This study uses a modified approach that combines features of both the zonal and individual observations models. This modified approach, first suggested by Brown, Shalloof and Hsiao (1984), is the individual per capita model. The dependent variable is the sum of trips taken by a given individual divided by some fraction of the population of that individual's origin

zone. The zonal population is equally allocated among all individuals observed to participate from a given zone. The advantage of this approach is that the model is estimated on the most disaggregated data possible (individual level observations) while avoiding the overestimation associated with the pure individual observation model.

The basic specification of the per capita or first stage TCM demand equation estimated for elk hunting is given in equation 1 as:

1) TRIPCAPij = Bo + B1(RDTRDISij) + B2(SUCCESSj) + B3(DEMOGi) + B4(SUBSTij)

where:

TRIPCAPij = trips taken by individual i to site j over the individual's share of origin population

RDTRDISij = round trip distance from the hunter's residence to the hunting area j

SUCCESSj = hunter success (ratio of kills to hunts) at site j

DEMOGi = socioeconomic variables such as income, age, sex, preferences that describe individual i

SUBSTij = a measure of the price and availability of substitutes to area j for individual i

The general specification shown here is the linear functional

form. However, all results discussed below are for a double log model where dependent and independent variables are transformed to natural log values. The linear model generally provides a poor fit to travel cost data. Both semi-log (log of the dependent variable) and double log models have been widely reported in the literature. The double log model is used here because it provides a good fit to the data, may correct for heteroscedasticity, and has an interpretation for differences in net economic values across sites (Duffield, 1987).

C) ASSUMPTIONS OF THE TRAVEL COST MODEL: ESTIMATION

As for any economic model, there are a number of assumptions involved in estimating the travel cost model. These assumptions fall in basically three groups: the specific assumptions of the travel cost model, the assumptions related to the basic economic theory of demand, and the statistical assumptions invoked in estimating the demand function.

The basic assumption of the TCM is that travel cost is equivalent to price in a site-based model of recreation demand. Aside from this special assumption, the general problem of modeling recreation demand is similar at the theoretical level to modeling demand for any commodity. Two very general requirements of an economic demand model are that the variables be correctly specified and the commodity being modeled is sufficiently

homogeneous to constitute a unique market. Both of these requirements have proved to be problematic for modeling nonmarket recreation.

With respect to variable definition, a major problem is that price is not directly observed and must be inferred from survey data. In many cases distance is taken as the price variable for estimation purposes and converted to travel costs by a fixed cents per mile travel cost parameter. In addition to direct monetary transportation costs, the real cost of travel includes the opportunity cost of time. There are several methods that have been developed for estimating both these components of travel cost. With respect to transportation cost, the standard approach recommended by the U.S. Water Resources Council is to use the variable cost of vehicle operation as defined by the U.S. Department of Transportation (1984) publications on the costs of owning and operating vehicles. However, because the latter does not necessarily reflect the actual costs associated with operating recreational vehicles, an estimate is also derived using data on reported trip expenditures by our sample of elk hunters. Both the standard and reported cost estimates are described in a following section of this report.

With respect to the opportunity cost of time, the Water Resources Council relies on Cesario's (1976) review of the value of travel time to urban commuters. The latter suggests using a value

between one-fourth and one-half the wage rate as a proxy for the opportunity cost of time. The approach taken in this study is to use one-third the wage rate for the opportunity cost of time.

In addition to correctly specifying the price variable, there are several methodological choices with respect to the quantity variable. It is generally agreed that the theoretically correct quantity variable is trips (McConnell, 1975). The specific formulation used here is the individual per capita model as described above.

A general demand model also needs to include variables reflecting income, preferences, and price and availability of substitutes. For all of these terms, demand theory provides some guidance as to the expected sign (direction) of the estimated relationship to quantity demanded. These hypothesis are used below to evaluate the estimated model.

The assumption of commodity homogeneity is also important for the travel cost model. In order to use trip expenditures as a price variable, it is necessary that travel costs be associated exclusively with visiting a given site. To ensure this aspect of trip homogeneity, the standard practice is to include only sample trips that are mainly for purposes of hunting a specific site (main purpose, single destination trips). As will be described below, approximately 15% of our sample was excluded as either

multi-destination or multi-purpose trips. Another aspect of homogeneity is that trips be generally similar with respect to duration. Because of limited sample size, this issue was not addressed.

A final assumption necessary for the TCM model is that there are no constraints on recreational use. In fact, only 17,000 nonresident elk tags (as part of a combination license) are sold each year. There is currently excess demand for these nonresident licenses. On the other hand, there is no limit on the number of resident elk tags. If all elk hunting in Montana was lottery rationed, it would be possible to estimate the TCM model entirely on application data (Loomis, 1982). However, a model that combines application and license data is appropriate for the complex licensing system in Montana. A sample of non-resident elk permit applicants (including successful permit holders) can be combined with the sample of resident hunters. This pooled sample can successfully represent the aggregate distribution of hunters that would be observed in the absence of the nonresident quota.

In addition to the nonresident 17,000 elk permit quota, the distribution of hunting pressure by area is influenced by a system of special permits. For example, in many hunting districts, cow elk can only be taken if the hunter has drawn a special permit for that area. These special permit quotas apply

to both residents and nonresidents for certain types of hunts. In order to analyze site level constraints, one would have to disaggregate sites and/or hunts to relatively homogeneous groupings. For example, a separate model might be estimated for special permit hunts for cow elk only. Additionally one would have to correct for any differences in the resident/nonresident ratio among permit holders compared to the ratio among the special permit applicants. Such an undertaking is beyond the scope of this project. In any case, the existing data base does not distinguish special permit from general permit hunts. Accordingly, site values should be interpreted with this caveat in mind. Because the special permit system influences the distribution of hunting pressure across sites, the differences in net economic values across sites reflect both the influence of the permit distribution system as well as underlying site values.

A final complication in modeling the demand for Montana elk hunting is that there is a substantial difference in license fees between residents ($10 for an elk tag or $35 for a combination license) and nonresidents (combination license only at $300). This issue is addressed below in Section V.

The basic method used for estimating the first stage demand curve (equation 1) is ordinary least squares regression analysis. The statistical assumptions include correct specification, assumptions related to statistical inference, and variable

measurement. The main specification issues from a statistical standpoint are the choice of regressors and the choice of functional form. If the estimated model is incomplete, there is a danger of omitted variable bias. Since the underlying model for OLS is linear, it is necessary that the variable transformations (implicit in the choice of functional form) result in a linear relationship. There is a considerable literature on functional form for travel cost models. The analysis reported below is based on the standard double log model. The statistical inference assumptions relate to the test statistics (such as the t-statistic and F-statistic) used to evaluate the model fit. These include homoscedasticity, independence of error terms (autocorrelation), normal properties of the dependent variable, and the assumption that no linear relationship exists between any two or more of the independent variables (multicollinearity). Generally, the major problem with estimating the travel cost model on cross-sectional data has been with heteroscedasticity. This is probably mainly due to incorrect functional form. This problem is specifically addressed below.

A final assumption is that the variables are correctly measured in the survey data. In the travel cost model, measurement error is potentially a problem, especially with respect to reported travel costs and/or distances. A related problem is that the travel cost model requires zonal aggregation. The costs of

defining population zones on other than political boundaries (county, state) are prohibitive. This aggregation will inevitably result in some survey distances (even if the latter are correct) that do not represent population-weighted averages. The methods used to define zones and validate distances are described below.

D) CALCULATION OF BENEFITS FROM THE PER CAPITA DEMAND EQUATION

Once the per capita demand equation of the form in equation 1 is estimated using OLS regression, benefits can be calculated in several ways. First, the per capita curve can be integrated for each zone of origin (or individual observation) between the current distance and the maximum distance assumed to be relevant for the model. Net economic value for each site is then the population-weighted sum of each zone's net willingness to pay. The alternative approach is to calculate a "second stage" or site demand curve from equation 1. This site demand curve relates total trips to a given site to increases in distance (or travel cost) over and above existing distance (or cost). The area under this curve is also an estimate of net willingness to pay. The approach used in this study is direct integration of the first stage demand curve since this is an exact method. The second stage approach involves either an approximation in estimating area (generally a numerical methods approach such as the

trapezoidal approximation is used) or an approximation in deriving a the second stage demand function (through regression analysis, for example). The general equivalence of these two approaches has been demonstrated in the literature (Burt and Brewer, 1971; Menz and Wilton, 1983).

The major assumption involved in benefit estimation is the choice of the appropriate upper limit of integration. With the double log model, trips per capita asymptotically approach zero as distance approaches infinity. The distance where trips fall close to zero may exceed a site's likely market area, and in any case the definition of a limit based on trips (one, "close to zero", etc.) is arbitrary. We have chosen to truncate the second stage demand curve at the highest observed distance in the sample. The equivalent limit for direct integration of the first stage equation is to integrate to the highest observed distance in the sample plus the observed distance from origin i to site j.

Another methodological option with respect to benefit estimation is the use of the actual intercept rather than the model estimated intercept. Gum and Martin (1975) were the first to utilize an actual intercept in estimating consumer surplus from a recreational demand function. Conceptually, when integrating a travel cost demand function, the intercept is the number of trips (quantity demanded) that would be taken at zero price. The

reason for using actual instead of predicted trips is that use of the former eliminates the error associated with estimating the intercept. It can be shown that with direct integration of the first stage demand function, only the parameter estimate on distance (travel cost) needs to utilized from the model; this helps eliminate specification bias. In the benefit estimates reported below, net economic values are based on actual trips using a modified Gum and Martin approach. Net economic values based on predicted trips are described in Appendix C.

III. DATA SOURCES

The main source of information on hunter's origin and site destination was obtained from a telephone survey of licensed hunters performed by Montana Department of Fish, Wildlife and Parks (DFWP). This survey was undertaken in January and February 1986. The survey involved mailing a short one page questionnaire and hunting map to hunters to be sampled. The hunter was told to answer as many of the hunting related trip questions as possible. The hunter was also told to expect a phone call from DFWP. In the phone interview, hunters read back their answers to questions already asked, and then answered a few additional questions. The two page survey was more a less a diary of the previous hunting season. Hunters were asked to list the sites visited, species hunted, travel distance, etc. for each big game hunting trip during the fall season. This survey instrument is provided in

Appendix A. This survey also asked information about trip expenditures, vehicle driven, and hunter demographics such as age, income, education, and years hunted.

The data was coded and entered into data files under the direction of Rob Brooks, Montana Department of Fish, Wildlife and Parks. There were a total of 696 completed surveys related to elk hunting. Each respondent was asked if the primary purpose of the trip was to hunt big game, if the area hunted was the primary place hunted, and for what species the hunter selected the given hunting area. The total main purpose, elk hunting only and single destination trips observations was 582. Excluding for missing origin information dropped the sample further to 553. Because of missing origin information, the ratio of nonresident hunters in the sample was examined. A total of only 56 or 10.1 percent of the 553 hunters sampled were nonresidents. This is considerably less than the actual 15.1 percent non-resident hunter proportion in Montana (based on the annual DFWP hunting pressure survey administered by John Cada). Accordingly, the nonresident sum of trips variable was inflated by approximately fifty percent. The latter data set comprised the base case for the travel cost model.

An alternative TCM data base was developed that would reflect the nonresident hunter proportion that would be observed in the absence of the 17,000 quota on nonresident permits. This data

base is described in the following section.

The 40 specific elk hunting areas originally defined for the study by DFWP personnel were based on aggregations of the 129 specific elk hunting districts specified in the DFWP elk hunting regulations. These areas are shown on the "Elk and Deer Hunting Areas" map in Appendix B. Because of the sample size, a number of the aggregated hunting areas (especially in Eastern Montana) had only a very few observations. All of the 600 and 700 districts were combined into a single hunting area (code 601) and all of the 500's into another (code 501). In addition the following areas were combined: 1AA, 1CC, 1GG, and 1HH into 101; 1BB, 1DD, 1EE, and 1FF into 102; 4AA and 4DD into 401; and 4BB and 4CC into 402. The net result is that the original 40 areas were reduced to 22 aggregated hunting sites.

In order to estimate the travel cost model, it was necessary to identify an origin zone for each individual hunter. Separate maps were developed for each hunting site and counties and states were aggregated in roughly concentric zones around the site. The basic criteria used in zonal aggregation was to have at least one observation per zone, to have the observation in a given zone be in an approximate population-weighted average location, and to have contiguous zones (no unaggregated areas) out to the limits of the observed spatial market. Typically zones nearest a site were single counties, with aggregates of counties defining the

origin zone around more distant observations. Nonresident origins were states or aggregates of states.

Because of the potential problem of measurement and/or aggregation error on the distance variable, the survey distance for each observation was examined for consistency with map distance. A total of nine specific observations were excluded because distances were not plausible given the origin and site visited. In addition, the majority of the Dawson County observations had distances that were inconsistent with the reported destinations. This may be a coding error. In any case, all 21 Dawson observations were excluded. A number of other observed distances were not necessarily representative of a population-weighted average. For example, an observation from Seeley Lake to hunt in the Swan Range would not have a representative distance for Missoula County population. However, calculating map distance for each of these is costly and introduces error due to uncertainty about the exact destination (many of the hunting sites are quite large). The approach taken was to exclude only clearly incorrect distances and to introduce no map calculated distances into the file.

In addition to survey data, two additional sources were used in developing the elk hunting data base. DFWP personnel in each region were surveyed by John Cada to identify the predominant management, topographic, roading, and timber characteristics of

each site. The management characteristics were based on the general type of hunting regulation: regular either sex (first week) and antlered bull, regular antlered bull and cow permits, regular branch-antlered bull and cow permits, and permit only. The extent of timber cover on each site was characterized on a scale of 1 to 4 from heavy timber to open. Topography was characterized as steep, general mountains or rolling hills. Roading was on a scale of 1 to 4 from unroaded to heavily roaded.

The other data source utilized was the annual hunting pressure and harvest survey administered by John Cada. This data was aggregated to develop measures of hunting success by site and total recreational values by site.

IV. NONRESIDENT ELK PERMIT DEMAND MODEL

As noted above, because of the constraint introduced by the nonresident elk permit quota, a random sample of Montana elk hunters does not provide an appropriate basis for the travel cost model. What is required is an estimate of the number of nonresident permit holders that would be observed in the absence of the quota.

Unfortunately, the number of nonresident permits that could have been sold in 1985 is not directly observable. The Montana DFWP did not retain the total nonresident permit applications received

for that year. In any case, the applications received understates the total potential permit sales. This is because the permits sold out very rapidly and many hunters who delayed their application phoned and discovered that the quota had been reached after only eight days. Jim Herman of the Montana DFWP reports that in 1985, DFWP personnel speculated that around 30,000 permits could have been sold. This is a subjective estimate based on the number of inquiries DFWP received even after the quota had been reached.

The approach taken here was to estimate a model that predicts the total non-resident elk permits that could have been sold in 1985 based on permit sales and permit prices in years prior to an effective quota. The general model is as follows:

2) $PERMITS_t = B_o + B_1(YEAR_t) + B_2(PRICER_t)$

where:

$PERMITS_t$ = number of nonresident elk permits sold in year t

$YEAR_t$ = year t

$PRICER_t$ = constant dollar nonresident elk permit price for year t

Real (constant dollar) prices were obtained by deflating nominal prices by the gross national product implicit price deflator (1972 equals 100). This simple model assumes that permits sold in any given year are a function of both price and an underlying

secular trend represented by time. The basic trend is probably a function of demographics (population age distribution), changes in tastes and preferences affecting hunter participation, income and systematic changes affecting the price and availability of substitute hunting areas (eg. Idaho, Colorado and Wyoming). The complexity of the model specification is of course limited by the available degrees of freedom in the sample.

Three specifications were explored: linear (shown in Equation 2), semi-log (log dependent) and double-log. The linear model implies that the time trend is characterized by a constant incremental increase over time. Both the log models imply a constant exponential rate of growth. The semi-log and linear models imply variable price elasticity, while the double-log model is a constant price elasticity model.

Although the 17,000 nonresident quota was instituted in 1976, the quantity demanded did not reach the 17,000 level until 1979. Accordingly, the years 1970 to 1978 provide evidence on unconstrained nonresident elk permit sales. The available data base is summarized in Table 1. This table shows non-resident elk permit sales, nominal and real prices, and the implicit price deflator series as available for 1970 to 1988.

Table 1

Montana Nonresident Elk Permit
Prices and Sales 1970-1988

Year	Permits	IPD	Pricen	Pricer
70	9500	91.40	151.00	165.21
71	11973	96.00	151.00	157.29
72	13970	100.00	151.00	151.00
73	19230	105.00	151.00	142.72
74	20560	115.10	151.00	131.19
75	25584	125.80	151.00	120.03
76	12689	132.30	225.00	170.07
77	13767	140.00	225.00	160.71
78	16553	150.40	225.00	149.60
79	17000	163.40	225.00	137.70
80	17000	178.60	225.00	125.98
81	17000	195.50	225.00	115.09
82	17000	206.90	225.00	108.75
83	17000	215.30	275.00	127.73
84	17000	223.70	300.00	134.11
85	17000	231.30	300.00	129.70
86	17000	236.50	350.00	147.99
87	17000	244.80	350.00	142.97
88		255.30	450.00	176.26

Notes: IPD = implicit price deflator (price index); PRICEN = nominal dollar price; PRICER = real price in constant 1972 dollars.

Model estimates are as follows:

3) PERMITSt = 25482.55 + 448.63 (YEARt) - 285.129 (PRICERt)

(t-statistic) (1.975) (2.804) (-10.563)

Adjusted R-square = .940 F-statistic = 63.457 Observations = 9

4) LPERMITSt = 19.123 + .0348 (YEARt) - 2.411 (LPRICERt)

(t-statistic) (11.733) (3.180) (-9.074)

Adjusted R-square = .924 F-statistic = 49.935 Observations = 9

5) LPERMITSt = 9.5399 + .0353 (YEARt) - .016786 (PRICERt)

(t-statistic) (11.190) (3.358) (-9.413)

Adjusted R-square = .929 F-statistic = 53.687 Observations = 9

All three models provide excellent fits to the data (based on the very high coefficient of determination). All variables are significant at the 95 percent level. On the basis of statistics alone, it is difficult to argue the superiority of any one model. The linear model implies a trend of increasing permit sales of 449 per year (after correcting for price). The log models show an exponential increase in permit sales (again controlling for price) of around 3.5 percent per year. The price response is, as one would expect, negative. The double-log model, for example,

indicates a price elasticity of -2.41.

This simple model shows the importance of correcting for increasing real prices. For example, the nominal (current dollar) price was unchanged at $151 between 1970 and 1975. In this period permit sales increased from 9500 to 25584 or 22 percent per year. However, in real terms (correcting for inflation) the price in this period actually dropped (in constant 1972 dollars) from $165 to $120. Much of the increased permit sales 1970 to 1975 appear to be due to response to declining real price. For example, when prices were increased in 1976 to $225, permit sales dropped from 25,584 to 12,689 (Table 1). However, because of inflation the 1976 price was (in constant dollars) just barely higher than the 1970 real price ($170 versus $165). Accordingly, a better comparison of years for the underlying trend is 1970 and somewhere between 1976 or 1977.

Results of using all three equations to predict nonresident elk permit sales are shown in Table 2. The linear model (Equation 2) predicts nonresident permit sales in 1985 of 26,634. Both the log models predict around 31,500 permits would have been sold in 1985. As noted, there is little evidence to argue the superiority of one model over another. These estimates are in the same range as the subjective estimate made by DFWP for 1985 of around 30,000 permits. The similarity of the subjective and predicted estimates is encouraging. However, it should be noted

Table 2

Montana Nonresident Elk Permits
Predicted Sales for Linear
Semi-log and Double-log Models

				PREDICTED PERMIT SALES		
Year	Pricen	Pricer	Permits	Doublelog	Semi-log	Linear
70	151.00	165.21	9500	10381.16	10263.85	9781.03
71	151.00	157.29	11973	12099.43	12143.46	12486.80
72	151.00	151.00	13970	13823.40	13980.78	14729.37
73	151.00	142.72	19230	16396.57	16641.79	17538.27
74	151.00	131.19	20560	20800.29	20921.39	21274.97
75	151.00	120.03	25584	26683.62	26137.18	24905.21
76	225.00	170.07	12689	11927.98	11689.98	11087.03
77	225.00	160.71	13767	14154.81	14168.55	14202.69
78	225.00	149.60	16553	17419.46	16787.40	17820.03
79	225.00	137.60	17000	22026.21	22374.52	21662.32
80	225.00	125.98	17000	28260.06	28216.87	25452.39
81	225.00	115.09	17000	36386.43	35093.16	29006.13
82	225.00	108.75	17000	43190.32	40436.49	31262.90
83	275.00	127.73	17000	30344.30	30459.74	26299.62
84	300.00	134.11	17000	27936.05	28349.28	24929.28
85	300.00	129.70	17000	31351.25	31621.91	26634.34
86	350.00	147.99	17000	23618.91	24097.73	21867.99
87	350.00	142.97	17000	26575.67	27156.75	23747.99
88	450.00	176.26		16613.42	16088.61	14704.16

that the predictive models are based on a nine year data base and are being used to extrapolate to a date seven years after the last data point.

There is little evidence that can be used to compare predictions to reality for the forecast period of 1979 to 1988. Obviously in every year the quota of 17,000 was reached so potential forecast sales need to be greater than 17,000 in every year. This is the case. In 1986 and 1987, DFWP did keep track of the number of applications received. This amounted to 22,000 and 24,148 applications for the two years respectively. However, nearly all permits were sold on the first day that they were available in both years. Accordingly, the permit totals in 1986 and 1987 are not comparable to sales in 1970 to 1978 when permits could be bought for an approximately 20 week period prior to the big game season. In any case, it is interesting to compare prediction for the most recent year (1987) to actual applications received of 24,148. Both the log models predict that only around 27,000 permits would have been sold in 1987 even if the full sale period was allowed (Table 2). The linear model actually slightly underpredicts (23,747) compared to applications received.

Also as shown in Table 2, the permit price for 1988 has been set at $450. Extrapolating the implicit price deflator at current rates of inflation implies this will be the highest constant (1972 dollars) dollar price for the period since 1970 (at $176).

In fact, all three models predict that nonresident permit sales will be under the 17,000 quota in 1988. This will provide a good test of the model, and possibly a new data point. It may well be that the underlying trend factors in the 1970's have accelerated in the 1980's.

To conclude, the nonresident elk permit demand models indicate that 26,500 to 31,300 nonresident elk permits could have been sold in 1985. Accordingly, the percent of nonresident hunters that would be observed in the sample population (in the absence of a quota on nonresident hunters) is between 21.6 and 24.7. The number of nonresident trips in the travel cost data base was increased by factors of 1.55 to 1.84 to reflect the estimated ratio of nonresident hunters.

The number of trips enters into the estimation of the first stage demand curve through the dependent variable, trips per capita. The base case trip per capita estimate is denoted as TRIPCP1 in the first stage demand curve estimates reported in Section VI below. The trips per capita that would be observed in the absence of a nonresident elk permit quota will be denoted as TRIPCP2 and TRIPCP3. These correspond to the linear and double-log model predictions of nonresident permit sales respectively. The influence of correcting for the nonresident elk permit quota on both the first stage equation and net economic benefits per trip is reported below.

V. TRAVEL COST PARAMETER ANALYSIS AND PRICE VARIABLE SPECIFICATION

As noted previously, site benefits are estimated by integration of the first stage demand function (equation 2). Since the price variable in the per capita demand equation is in terms of miles, integration of this function yields net values that are also in distance terms. In order to calculate net economic values, hunter willingness to pay must be converted to monetary terms. This is accomplished by multiplying distance by a cost per mile. This travel cost per mile is the sum of two components: time opportunity cost per mile and variable out-of-pocket expenses (including vehicle operation). Travel cost parameters were derived by two methods: using the Water Resources Council guidelines (standard) and using hunter reported costs (reported). The opportunity cost of time will be discussed first.

A) OPPORTUNITY COST OF TIME

Opportunity cost of time reflects the deterrent effect that longer drives have on visiting more distant sites, independent of vehicle operating costs. For example, many higher income people could afford the extra $8.00 or so of gasoline cost incurred if they drove an additional two hours to hunt, but many could not "afford" the additional time cost in terms of other activities

foregone.

As noted previously, some fraction of the hourly wage is generally used as a proxy for this opportunity cost of time. This is in part due to the work of Cesario (1976) which showed the opportunity cost of time in commuting studies equaled between one-fourth and one-half of the wage rate. Based on this work, the Water Resources Council recommends using the opportunity cost of time in recreational travel at one-third the wage rate. For our study, this estimate is 7.6 cents per mile based on an estimated wage rate for our sample of hunters of $10.25 per hour and 45 miles per hour speed of travel. The hourly wage is derived from average household income for the elk hunter sample (27,570 based on 637 observations) and the ratio of U.S. median household income to average hourly earnings (Statistical Abstract, 1986). The latter implies an average of 2691 hours of work per household.

Other empirical evidence on the cost of travel time is provided by a study of Rhode Island saltwater sport anglers (McConnell and Strand, 1981). A comparison of the deterrent effect of travel time and monetary travel cost indicated that anglers valued the time spent traveling at about 60% of the wage rate. The McConnell and Strand model was estimated on the elk hunting data base. The estimated parameters on trips costs and time were not significant at the 90 percent level. Accordingly, the Water

Resources method estimate of 7.6 cents per mile for the opportunity cost of time will be used for both the standard and reported travel cost parameters.

B) EXPENDITURE DATA

Before presenting the analysis of the transportation cost component, it is useful to review the expenditure data used in the travel cost parameter analysis. The hunter expenditure data is summarized in Tables 3,4, and 5 for the complete sample, residents and nonresidents respectively. The expenditure data is from the response to the questions on the second page of our survey (Appendix A). Questions 1 to 8 (on page two of our survey) asked for detailed information with respect to a single randomly selected trip. Because the random trip may or may not have been an elk hunting trip, there are only about half as many observations for these variables (278 responses with complete information compared to the full sample of 696 observations).

Means for all variables are shown with and without missing values set to zero. For example guiding fees averaged $1430.21 based on 24 observations. However, the average expenditure on guiding fees for the entire sample (assuming missing values equal zero) is $106.39. Total expenditures per trip for the complete sample are $285.00 (Table 3). Resident expenditures per trip averaged $81.14 (Table 4) while non-resident expenditures were $1399.12

Table 3

Montana Elk Hunting
Average Expenditures in 1985

Variable	Mean	Observations	Mean at n=278*
TRNSCST	96.69	278	96.69
LODGING	111.44	45	17.97
STORES	50.25	211	37.48
REST	49.01	100	17.38
FEES	1430.21	24	106.39
OTPURCH	60.98	44	9.10
TOTLCST			285.00

*Missing values coded to zero

Table 4

Resident
Montana Elk Hunting
Average Expenditures in 1985

Variable	Mean	Obvservations	Mean at n=235*
TRNSCST	44.05	235	44.05
LODGING	44.85	13	2.48
STORES	34.41	180	25.66
REST	17.64	63	4.64
FEES		-0-	
OTPURCH	37.21	28	4.32
TOTLCST			81.14

*Missing values set at zero

Table 5

Non Resident
Montana Elk Hunting
Average Expenditures in 1985

Variable	Mean	Observations	Mean n=43*
TRNSCST	384.42	43	384.42
LODGING	138.50	32	102.61
STORES	142.23	31	102.07
REST	102.43	37	86.98
FEES	1430.21	24	687.79
OTPURCH	102.56	16	35.26
TOTLCST			1399.12

*Missing values coded to zero

(Table 5). It is interesting to note that nonresidents traveled an average of 2878 miles round trip to hunt elk in Montana, while resident trips averaged 194 miles round trip. Residents on average took two elk hunting trips over the season, while nonresidents took one.

C) VARIABLE TRANSPORTATION COSTS

Variable out-of-pocket travel expenses for Montana elk hunters was also calculated by two different methods. The "standard' approach recommended by the Water Resources Council is based on the variable costs of operating a motor vehicle. The latter was obtained from the U.S. Department of Transportation's Cost of Owning and Operating Vehicles and Vans 1984 and is 15.2 cents per mile. The latter is based on the variable cost of operating a large size vehicle, since the latter most closely approximates engine efficiencies and size of typical vehicles utilized by hunters. For example, 77 per cent of our sample of Montana hunters reported driving 4WD vehicles and 12 per cent full size vehicles. Only 6 per cent utilized compacts or intermediates. The "standard" cost per passenger mile is then 5.8 cents based on our sample average of 2.63 hunters per vehicle.

The reported variable travel cost is derived by regressing reported trip expenditures on distance traveled. The estimated slope coefficient on distance can then be interpreted as the

variable monetary cost of travel (Burt and Brewer, 1971). The reported estimate differs from the standard in that all trip costs (not just vehicle operating costs) are included. In addition, the estimate is derived from hunter survey data. The estimated equation based on the Burt and Brewer method is as follows:

5) TOTLCS1 = 4.230 + .461 RDTRDIS
(t-statistics): (1.206) (28.011)

Adjusted R-square = .739, Observations = 278, F-statistic = 784.63

where:

TOTLCS1 = sum of reported hunter expenditures on transportation, lodging, food, guide fees, and other purchases

RDTRDIS = round trip distance from hunter's residence to area hunted

This simple model shows that total trip expenditures (defined to include transportation costs plus food, lodging, guide fees and other purchases) are a function of distance traveled to the area hunted. The R-square statistic shows that the model has high explanatory power. The coefficient on distance (.461) is precisely estimated, as indicated by the high t-statistic value for this parameter. The coefficient on distance can be

interpreted as the variable cost per mile traveled or 46 cents per mile.

It should be noted that the estimate reported above is based on the assumption that all missing values for hunter expenditures are equal to zero. Some assumption on missing values was necessary since the total number of observations with complete trip expenditure data was only four. This is because many hunters did not report certain categories of expenditure such as guiding fees. The assumption that all missing values are zero is the most conservative possible.

Because resident and non-resident trip expenditures differ considerably, an alternative specification was also examined that includes a dummy variable for non-resident hunters (NONRSDUM):

6) TOTLCS1 =	14.011	+	.346 RDTRDIS	+	388.71	NONRSDUM
(t-statistic)	(.691)		(9.793)		(3.647)	

Adjusted R-square = .750, F-statistic = 784.64, Observations = 278

The nonresident dummy variable is highly significant. The effect of the nonresident dummy is to lower the variable transportation cost estimate from 46.1 cents to 34.6 cents. Equation 6 corrects for costs that are generally unique to nonresident hunters (such

as guiding fees) and results in a variable cost that is more appropriate for both residents and nonresidents.

The coefficient on NONRSDUM may be interpreted to mean that nonresident trip expenditures over and above variable transportation cost are $389 higher than for residents. This is consistent with the expenditure data summarized above. Since all nonresidents in our sample took only one elk hunting trip, the variable trip expenditures for nonresidents can be represented by the sum of the variable transportation costs and the nonresident extra trip costs of 389. The intercept (constant term) is not significantly different than zero and can be ignored.

The parameters in Equation 6 will be used in the analysis below rather than the more conventional Burt and Brewer model shown in Equation 5. Equation 6 with variable costs at 34.6 cents per mile results in net economic benefits that are conservative compared to using 46.1 cents per mile from Equation 5.

The variable transportation cost component for elk hunting trips is somewhat higher than the 30 cents per mile estimated for deer hunting trips from the same data base (Brooks, 1987). This is consistent with the differences in trip expenditures; total expenditures per trip also tend to be higher for elk hunting than deer hunting. Another comparison is to Sorg and Nelson's (1985) study of elk hunting in Idaho. They estimated reported travel

costs for elk of 31 cents (including time) which was higher than the companion study estimate for deer hunting.

Table 6 provides a summary of the travel cost parameter values used in this study. The standard cost estimate (following the Water Resources Council method) is 13.4 cents per mile. The reported cost estimate is 42.2 cents per mile based on the sum of the opportunity cost of time (7.6 cents) and the variable transportation cost component (34.6).

D) PRICE VARIABLE SPECIFICATION

Because trip expenditure data is limited to a subsample, it is necessary to estimate the first stage equation on roundtrip distance. This is the conventional approach, with the travel cost parameter (cents per mile) entering at the benefit estimation stage of the methodology. As is usual, resident trip expenditures can be represented by roundtrip distance as an index for the price variable. However, given the findings in Equation 6, the price variable for nonresidents is roundtrip distance plus 921 miles (388.71 divided by .422). The latter is the distance equivalence of the fixed costs per trip identified for nonresidents. The price variable denoted by this specification is labeled RDTRDS1 in the estimates described below.

In order to symmetrically represent the standard cost case, the

Table 6

Travel Cost Parameters
(Cents per mile)

	Transportation Cost	Opportunity Cost of time	Sum
Water Resource Council Method	5.8	7.6	13.4
Reported	34.6	7.6	42.2

nonresident price variable is specified to include a fixed trip cost of 2900 miles (388.71/.134). This variable is denoted as RDTRDS1A.

As was noted in the methodological summary of Section II, nonresident permit fees of $300 are an additional fixed cost per trip for nonresidents. This interpretation is valid because nonresidents take only one elk hunting trip per season. This permit fee was not included in the expenditure data described above, but is obviously a valid cost. An alternative price variable specification is therefore to include nonresident permit fees in the fixed cost component. This implies a distance equivalent for fixed nonresident trip costs of 1630 miles (300 plus 388.71 all divided by .422). The effect of this specification (RDTRDS2) on average net economic values per trip is described below.

VI. STATISTICAL ESTIMATION OF ELK HUNTING DEMAND EQUATION

The basic variables used in the elk hunting (first stage) demand equation are shown in equation 1. The specific variables used in preliminary regression estimates included demographic variables such as age, income, education and years of hunting experience; success variables included total harvest, bull harvest, and success ratios for total kill and bull kill. The site variables

relating to management characteristics, topography, roads and timber were coded into dummy (0 or 1) variables. Two substitute variables were defined from the survey data. One was a dummy variable based on the yes/no response to whether there was a substitute elk hunting site available to the hunter. A second substitute variable was based on the survey response to (if yes a substitute exists) the named substitute area and the distance to that substitute area. Substitute distance was calculated from the sample using actual trips from a given origin to the named substitute. Distance to a substitute was used as a measure of substitute price. One would expect that the more costly substitute hunting trips were for an individual, the more trips that hunter would make to the current site (other things equal). Accordingly, one would expect a positive sign on the substitute price (distance) variable in the same way one would expect a positive sign, for example, on a natural gas price variable in a model of residential electricity demand.

As noted in the preceding section, the price variable specification differs slightly between the reported (RDTRDS1) and standard (RDTRDS2) cost cases. With respect to the dependent variable, trips per capita, it will be recalled that the base case dependent variable (LTRIPCP1) does not include a correction for the nonresident permit quota. The results of the estimation of the base case version of Equation 1 (double log specification) for reported costs is as follows:

7) LTRIPCP1 = -.810 -1.469 LRDTRDS1 + .228 LYRSHUNT
(t-statistics): (-1.491) (-30.557) (3.352)

-.215 LYRSHNT1 +.261 LBULSUCS
(-2.602) (1.995)

where:

LTRIPCP1 = log of trips by individual i to site j over fractional zonal population (trips per capita) not adjusted for nonresident elk permit quota

LRDTRDS1 = log of round trip distance from residence of i to site j where nonresident includes fixed trip distance of 388.71/.422

LYRSHUNT = log of number of years individual i has hunted site j

LYRHNT1 = log of number of years individual i has hunted

LBULSUCS = log of bull success ratio (bulls harvested over total number of hunters) at site j

Adjusted R-square =.715, Observations = 505, F-statistic = 318.49

The adjusted R-square statistic and F-statistic are quite high for a travel cost model, and indicate that the model provides a good fit to the data. All the estimated coefficients are significant at the 95% level or better and have the expected sign. It may be noted that the sign on the number of years hunting at the specific site is positive; this is consistent with

hunters preferring to hunt areas they are familiar with. The negative correlation between total hunting experience and trips per capita in part reflects the fact that nonresident hunters tend on average to have more overall hunting experience than residents. The negative correlation reflects the fact that nonresidents are less likely to visit any given area.

The key parameter for purposes of consumer surplus estimation is the slope coefficient on distance. The very high t-statistic for this parameter indicates that it is precisely estimated.

None of the site characteristic variables other than success were significant, and most of the demographic variables (such as income) were also not significantly correlated to per capita trips. Due to missing data limitations, the substitute variable could only be tested on a subsample of the data (221 observations compared to 504 with complete information used in estimating equation 2). The substitute variable came in significant but with the wrong sign. This may indicate complementarity between sites. A more likely possibility is that the substitute variable is functioning like another own-price variable: origins far from a given hunting area also were far from substitutes (substitute variable and round trip distance had a simple correlation of .480). In any case, the sample with substitute information was limited to almost entirely residents (only 3 of 221 substitute observations were nonresidents) and was too small to use for the

general model.

In addition to statistical significance and consistency with the theoretical model, the travel cost demand model estimate can be evaluated on how well it predicts. While the model is estimated on per capita trips, it is accurate prediction of total trips that is critical for the consumer surplus estimate. Trip prediction at the site level compared to actual for equation 7 is shown in Table 7. The model overestimates total trips for the sample: 2301 predicted trips versus 1043 actual. Examination of trip prediction at the observation level revealed that most of the overprediction is for origins very close to hunting sites (low distances). The model also overpredicts for far distances.

Because of the prediction problems, the model was tested for heteroscedasticity using the Glejser (1969) test. It was found that residuals were significantly correlated to distance. These results indicate that the double log transformation is not entirely successful at producing a model that is linear in the transformed variables.

The base case estimate for the standard travel cost price variable specification is as follows:

8) LTRIPCP1 =	-1.144	-1.407 LRDTDS1A	+ .205 LYRSHUNT
(t-statistic)	(-2.22)	(-32.410)	(3.130)

Table 7

Montana Elk Hunting
Actual Versus Predicted Trips

Hunting Area	Area Number	Observations	Total Trips	Predicted Trips
Kalispell	101	29	50.05	170.52
Libby	102	31	79.00	66.97
Superior	211	14	40.58	56.35
Hamilton	222	17	55.74	121.86
Flint Creek	233	25	59.58	104.20
Ovando	244	35	55.74	142.70
Pioneers	311	34	92.89	155.64
Gravelly	333	19	34.16	40.42
Madison	344	41	70.47	142.72
Gardiner	355	43	75.74	89.78
Bridger	366	24	52.00	206.61
Townsend	377	38	68.31	112.94
Butte	388	13	25.00	76.50
Tobacco Root	399	24	50.31	255.06
Augusta	401	23	43.16	108.43
Great Falls	402	18	31.89	55.87
Wolf Creek	455	22	43.00	236.27
Little Belts	466	18	29.58	57.11
Lewistown	477	19	40.58	76.37
Billings	501	14	17.00	9.59
Eastern Mont	601	19	27.74	14.95
Totals		520	1042.50	2300.87

-.183 LYRSHNT1 +.251 LBULSUCS

(2.295) (1.959)

Adjusted R-square = .737, F-statistic = 354.59, Observations = 505

where:

LRDTDS1A = log of round trip distance from residence i to site j with nonresident fixed trip expenditures at 388.71/.134

(other variables as defined above).

As can be readily noted, Equation 8 is very similar to the reported cost specification in Equation 7. One difference is that the price response parameter indicates the standard case is somewhat less elastic.

The effect of correcting for the nonresident elk permit quota on the first stage demand curve was explored by estimating the specification shown in Equation 7 (reported cost), but using the permit quota corrected trip per capita estimates. As was described above in Section IV, if there was no nonresident permit quota, there would of course be an increased proportion of nonresident hunters in the sample. The base case described above (TRIPCP1 is the dependent variable) does not correct for the permit quota and therefore implies nonresident permit sales of 17,000 and a nonresident proportion of 15.1 percent in the

sample. TRIPCP2 is the trip per capita variable for the linear model prediction of about 26,500 nonresident permits and a nonresident proportion of about 21 percent. TRIPCP3 is the trip per capita variable for the double log model prediction of about 31,300 permit sales and a nonresident proportion of 25 percent. In other words, if there was no quota on nonresident permits, there would be more nonresident trips in our sample and more nonresidents in the total Montana elk hunting population.

The first stage demand curve estimates for TRIPCP2 and TRIPCP3 are very similar to Equation 7. The main difference is in the estimated coefficient on distance which is -1.469 in the base case and -1.409 and -1.385 for TRIPCP2 and TRIPCP3 respectively (the cases where the effect of the quota is removed). The coefficients in a double-log model are elasticities. This means that they show the percent change in the dependent variable for a one percent change in the independent variable. In the base case, trips per capita drop off more rapidly with distance (declining 1.469 percent for every one percent increase in distance). If nonresident hunters did not face a quota on permits, we would see more nonresident hunters. This is reflected in the model estimate, for TRIPCP3 for example, that shows trips dropping off at a lower rate (elasticity of 1.385) than the base case. The difference is, however, not very great in absolute terms. The effect on the net economic benefits per trip will be noted below.

A final result with respect to the first stage estimates is the effect of including the nonresident elk permit fee of $300 in the price variable specification. As described above, this is the specification for the variable RDTRDS2. When the latter is included in an equation with LTRIPCP3 as the dependent variable, the elasticity is even lower at -1.340. It may be noted that trip prediction is almost identical for the base case and all of these alternative models.

VII. BENEFIT ESTIMATES

Net economic values for Montana elk hunting were derived from the first stage demand functions shown in equations 7 and 8. The next section presents these estimates.

A) NET ECONOMIC VALUES FOR MONTANA ELK HUNTING

As explained above, (Section II.C) there are several methodological choices involved in estimating net economic values from a given first stage demand curve. These choices include method of integration, upper limit of integration and the intercept term for the second stage demand curve. Each of these choices will be briefly summarized for the application at hand.

The method of integration used here is direct integration of the

first stage demand curve (rather than using a numerical methods approximation on the second stage curve). The upper limit of integration in the following tables for any given observation is the furthest observed distance traveled in the sample plus the observed distance. This corresponds to facing each hunter with a hypothetical site fee no higher than the maximum travel cost observed to have been expended to visit Montana elk hunting areas.

The final methodological choice with respect to benefit estimation is whether to use actual observed trips or model predicted trips as the intercept term on the second stage demand curve. It may be recalled that for the second stage demand curve, the intercept with the quantity axis corresponds to the number of trips taken at zero price. The conventional method is to use a predicted intercept (or predicted trips) as the starting point for integrating the area under the demand curve. However, as may be recalled from Table 7, the model estimated here (Equations 7 and 8) tends to overpredict the number of trips (as compared to actual observed trips) for some sites. Accordingly, the benefit estimates reported below are derived using the Gum and Martin method (intercept based on actual trips) to avoid the error that may be introduced by poor trip prediction. For comparison purposes, net economic values using the conventional method (predicted intercept term) are described in Appendix C.

Consumer surplus per trip based on equations 7 and 8 is shown in Tables 8 and 9. The site average value per trip based on the standard cost parameter (13.4 cents per mile) is $80.41 and the average based on the reported trip costs (42.2 cents per miles) is $195.30. The range across sites for the latter is considerable. The values per day based on the site specific average days hunting per trip are $26.90 and $66.06 for the standard and reported cost estimates respectively.

The averages shown in Tables 8 and 9 are simply averages across sites. In other words, each site counts equally in the average independent of how many hunters visit that site. In the following section total site values are derived based on the amount of hunting pressure each site receives. The total site values can then be used to estimate state average values that are weighted by the hunting pressure at each site. Additionally, it may be noted again that the estimates in Tables 8 and 9 are based on the actual distribution of trips by origin and destination (the Gum and Martin method described above). In Appendix C, estimates are derived based on the distribution of trips predicted by the estimated models (Equations 7 and 8).

B) SITE RECREATIONAL VALUE

The total recreational value of Montana hunting areas can be estimated by multiplying hunting pressure (estimated total days

Table 8

Montana Elk Hunting
Net Economic Value Per Trip
Gum and Martin Method
(Standard Cost)

Area Number	Hunting Area	Value Per Trip	Avg Days Per Trip	Value Per Day	Obser-vations
101	Kalispell	165.53	4.53	36.54	29
102	Libby	30.01	1.59	18.81	31
211	Superior	41.27	3.26	12.66	14
222	Hamilton	68.29	2.02	33.88	17
233	Flint Creek	42.37	1.67	25.45	25
244	Ovando	86.63	3.15	27.50	35
311	Pioneers	83.81	2.77	30.22	34
333	Gravelly	94.34	3.16	29.84	19
344	Madison	125.32	3.28	38.23	41
355	Gardiner	77.48	2.66	29.15	43
366	Bridger	23.17	1.29	17.98	24
377	Townsend	71.35	2.30	30.99	38
388	Butte	13.95	1.60	8.72	13
399	Tobacco Root	101.63	3.58	28.36	24
401	Augusta	79.71	2.66	29.96	23
402	Great Falls	178.83	3.57	50.08	18
455	Wolf Creek	31.32	1.91	16.42	22
466	Little Belts	93.09	3.36	27.71	18
477	Lewistown	73.57	3.43	21.46	19
501	Billings	64.66	3.47	18.63	14
601	Eastern Mont	142.20	4.40	32.33	19
Site Averages		80.41	2.84	26.90	

Table 9

Montana Elk Hunting
Net Economic Value Per Trip
Gum and Martin Method
(Reported Cost)

Area Number	Hunting Area	Value Per Trip	Avg Days Per Trip	Value Per Day	Obser-vations
101	Kalispell	385.41	4.53	85.07	29
102	Libby	84.48	1.59	52.97	31
211	Superior	100.89	3.26	30.95	14
222	Hamilton	157.66	2.02	78.21	17
233	Flint Creek	109.02	1.67	65.47	25
244	Ovando	208.65	3.15	66.24	35
311	Pioneers	204.74	2.77	73.81	34
333	Gravelly	225.47	3.16	71.31	19
344	Madison	299.71	3.28	91.42	41
355	Gardiner	193.93	2.66	72.96	43
366	Bridger	65.18	1.29	50.58	24
377	Townsend	161.31	2.30	70.06	38
388	Butte	39.15	1.60	24.47	13
399	Tobacco Root	236.19	3.58	65.92	24
401	Augusta	199.45	2.66	74.96	23
402	Great Falls	403.41	3.57	112.98	18
455	Wolf Creek	88.10	1.91	46.20	22
466	Little Belts	240.28	3.36	71.53	18
477	Lewistown	192.88	3.43	56.27	19
501	Billings	181.97	3.47	52.43	14
601	Eastern Mont	323.50	4.40	73.56	19
Site Averages		195.30	2.84	66.06	

of hunting per year) times the values per day shown in Tables 8 and 9. This method implies that multiple destination and multiple purpose trips are at least as valuable as the trips that satisfy the travel cost model requirements described in Section II above. Independent evidence from contingent valuation method studies suggest that this is so. Based on the standard cost approach, the total recreational value of Montana elk hunting sites is $15.3 million per year (Table 10). The corresponding estimate based on reported cost is $37.6 million (Table 11). The hunting pressure estimates are from the Montana Department of Fish, Wildlife and Parks annual big game hunting survey administered by John Cada.

State average (pressure-weighted average) values for elk hunting per day can be derived from the totals in Tables 10 and 11. For standard cost the value per day is $26.65 and the value per trip (based on the sample average days per trip of 2.81) is $74.89. The corresponding estimates for the reported cost basis are $65.58 and $184.56 per day and per trip respectively. It may be noted that these pressure-weighted averages are slightly lower than the simple site averages reported in Tables 8 and 9; this reflects the fact that hunting pressure is, on average, somewhat higher at the lower value sites. This distribution of use may in part reflect the effects of the system of special site-specific permits. The value of a Forest Service Recreation Visitor Day (based on our sample average of 6.299 hours of hunting per day)

Table 10

Montana Elk Hunting
Total Recreational Value of Sites
Gum and Martin Method
(Standard Cost)

Area Number	Hunting Area	Value Per Day	Sample Days	Hunting Pressure	Site Value 000$
101	Kalispell	36.54	226.74	38271.00	1398
102	Libby	18.81	126.00	70863.00	1333
211	Superior	12.66	132.29	34412.00	436
222	Hamilton	33.88	112.35	51601.00	1748
233	Flint Creek	25.45	99.21	29906.00	761
244	Ovando	27.50	175.57	52070.00	1432
311	Pioneers	30.22	257.66	39824.00	1203
333	Gravelly	29.84	107.99	21830.00	651
344	Madison	38.23	231.02	25462.00	973
355	Gardiner	29.15	201.30	24090.00	702
366	Bridger	17.98	67.00	15500.00	279
377	Townsend	30.99	157.29	26370.00	817
388	Butte	8.72	40.00	15082.00	131
399	Tobacco Root	28.36	180.28	20735.00	588
401	Augusta	29.96	114.83	22326.00	669
402	Great Falls	50.08	113.87	13474.00	675
455	Wolf Creek	16.42	82.00	28020.00	460
466	Little Belts	27.71	99.36	19199.00	532
477	Lewistown	21.46	139.10	10345.00	22
501	Billings	18.63	59.00	12930.00	241
601	Eastern Mont	32.33	121.98	104.00	3
State Total				572,414.00	15,254

Source: Equation 8

Table 11

Montana Elk Hunting
Total Recreational Value of Sites
Gum and Martin Method
(Reported Cost)

Area Number	Hunting Area	Value Per Day	Sample Days	Hunting Pressure	Site Value 000$
101	Kalispell	85.07	226.74	38271	3256
102	Libby	52.97	126.00	70863	3753
211	Superior	30.95	132.29	34412	1065
222	Hamilton	78.21	112.35	51601	4036
233	Flint Creek	65.47	99.21	29906	1958
244	Ovando	66.24	175.57	52070	3449
311	Pioneers	73.81	257.66	39824	2940
333	Gravelly	71.31	107.99	21830	1557
344	Madison	91.42	231.02	25462	2328
355	Gardiner	72.96	201.30	24090	1758
366	Bridger	50.58	67.00	15500	784
377	Townsend	70.06	157.29	26370	1847
388	Butte	24.47	40.00	15082	369
399	Tobacco Root	65.92	180.28	20735	1367
401	Augusta	74.96	114.83	22326	1673
402	Great Falls	112.98	113.87	13474	1522
455	Wolf Creek	46.20	82.00	28020	1295
466	Little Belts	71.53	99.36	19199	1373
477	Lewistown	56.27	139.10	10345	582
501	Billings	52.43	59.00	12930	678
601	Eastern Mont	73.56	121.98	104	8
State Total				572,414	37,598

Source: Equation 7

is \$50.77 for standard cost and \$125.13 for reported cost.

C) SENSITIVITY ANALYSIS OF BENEFIT ESTIMATES

This section provides a sensitivity analysis of benefit estimates. Benefit estimates in a travel cost model can be influenced both by the method of calculating benefits and by the model specification. Each is discussed in turn here.

The Gum and Martin method results of Tables 8 through 11 can be compared with the results of the conventional benefit estimation method described in Appendix C. Results from both methods are summarized in Table 12. Generally speaking, the conventional estimates are about 65 percent larger than the Gum and Martin estimates. For example, for the reported cost basis, the Gum and Martin estimate is \$185 per trip, while the conventional method is \$306 (Table 12).

The differences between the two groups of estimates in Table 12 are explained by the fact that for double log travel cost models, net economic values per trip are closely related to the trip-weighted average distance of hunting trips taken to a given site. (The mathematical basis for this relationship is derived in Duffield, 1987.) The effect of poor trip prediction is that trip-weighted average distance may be incorrect. For Equations 7 and 8, a specific problem is that trips from far distances tend

Table 12

Montana Elk Hunting
Comparison of Net Economic Values
Conventional versus Gum and Martin Method

Estimate	Conventional		Gum and Martin	
	Standard Cost	Reported Cost	Standard Cost	Reported Cost
Value per day[1]	41.36	108.74	26.65	65.68
Value per trip[2]	116.22	305.56	74.89	184.56
Value per WFUD[3]	78.79	207.16	50.77	125.13

[1]State pressure-weighted averages, based on Equations 7 and 8.

[2]Based on sample average of 2.81 days/trip

[3]Based on sample average of 6.299 hours of hunting/day.

to be overpredicted; this has the effect of overstating average distance and site value. As an example, Table 13 compares actual average distance and predicted average distance. For unit 355, Gardiner, the actual average distance traveled to hunt this area is 391 miles. However, because trips to two distant origins (in this case, at 2000 and 3600 miles respectively) are overestimated, the predicted average distance is too high at 2185 miles (Table 13). The corresponding effect on net economic values per trip can also be observed in Table 13. The value per trip using the conventional benefit estimation method (predicted trips as in Appendix C) is $775 for trips to the Gardiner area. This is much higher than the value per trip estimate from the Gum and Martin method for Gardiner ($194).

This analysis shows that benefit estimates are sensitive to the basis of the second stage demand curve intercept term (actual versus predicted trips). It would appear that site level estimates based on the Gum and Martin method are preferred for the case at hand.

With regard to model specification, it may be recalled that several alternative specifications of the first stage demand curve have been previously discussed. One set of alternatives is based on different definitions of the dependent variable (trips per capita). Specifically, TRIPCP2 and TRIPCP3 are variables representing the number of trips per capita that would be

Table 13

Montana Elk Hunting
Predicted Versus Actual
Consumer Surplus Per Trip
Reported Cost Basis (42.2 cents/mile)

Hunting Area	Obser-vation	Actual Surplus	Average Distance	Actual Predicted Surplus	Predicted Average Distance
Kalispell	29	385.41	1099.62	552.46	1689.39
Libby	31	84.48	112.81	55.02	75.25
Superior	14	100.89	200.35	482.57	1259.49
Hamilton	17	157.66	346.06	225.09	554.27
Flint Creek	25	109.02	197.48	211.80	514.89
Ovando	35	208.65	424.77	219.29	540.49
Pioneers	34	204.74	477.91	405.52	1209.96
Gravelly	19	225.47	430.31	471.80	1098.20
Madison	41	299.71	712.18	528.49	1545.51
Gardiner	43	193.93	391.24	774.92	2185.44
Bridger	24	65.18	85.73	24.65	33.62
Townsend	38	161.31	356.65	408.30	1165.19
Butte	13	39.15	48.88	35.16	43.58
Tobacco Root	24	236.19	550.53	124.10	304.56
Augusta	23	199.45	468.28	477.06	1437.84
Great Falls	18	403.41	961.57	349.69	852.24
Wolf Creek	22	88.10	122.98	22.13	30.63
Little Belts	18	240.28	428.91	334.45	752.06
Lewistown	19	192.88	350.46	831.72	2305.09
Billings	14	181.97	274.71	146.00	206.43
Eastern Mont	19	323.50	682.98	155.91	219.34
Means	24.76	195.30	415.45	325.53	858.26

Source: Equation 7

observed if nonresident elk permit sales were about 26,500 or 31,300, respectively. By contrast, TRIPCP1 is the base case described above (Equations 7 and 8 and the results shown in Tables 7 through 12), based on the existing permit quota of 17,000. State pressure-weighted average values for alternative specifications are summarized in Table 14 for the reported cost basis.

Case A is the base case, with value per trip of $305.56 for the conventional method and $184.56 for the Gum and Martin method, as previously described. Case B provides the average value per trip when model parameters are based on the potential demand represented by predicted sales of 26,500 nonresident permits. A Case B estimate ($195.65) is available only for the Gum and Martin method. While model parameters are based on total potential nonresident demand, the ratio of nonresident trips in Case B (15 percent) is still constrained to represent the actual nonresident trips made under the current quota. (Accordingly, no Case B estimate can be made for the conventional method since the model would predict a nonresident trip proportion of greater than 15 percent.) Case C is similar except that the predicted sales of nonresident permits is about 31,300. The Case C Gum and Martin estimate is $200.44.

On theoretical grounds, the values in Case B and Case C are probably the most consistent representation of the current elk

Table 14

Montana Elk Hunting
Summary of Alternative
Travel Cost Model Specifications
Net Economic Value Per Trip
(Reported Cost Basis)

Case	Dependent Variable	Price Variable	Net Economic Value Per Trip: Conventional	Net Economic Value Per Trip: Gum & Martin
A.	Base Case - no correction for non-resident permit quota.			
	TRIPCP1	RDTRDS1	305.56	184.56
B.	Model parameters based on 26,500 non-resident permit sales.			
	TRIPCP2	RDTRDS1	N.A.	195.65
C.	Model parameters based on 31,300 non-resident permit sales.			
	TRIPCP3	RDTRDS1	N.A.	200.44
D.	Model parameters and non-resident trips based on 26,500 permits.			
	TRIPCP2	RDTRDS1	333.50	209.48
E.	Model parameters and non-resident trips based on 31,300 permits.			
	TRIPCP3	RDTRDS1	341.86	219.97
F.	Same as C, but price variable includes $300 non-resident fee.			
	TRIPCP3	RDTRDS2	N.A.	220.83

hunting market in Montana. The model parameters are based on the total potential nonresident demand, but the state average value per trip reflects the fact that nonresidents are only about 15 percent of the hunting population (rather than the 21 to 25 percent that would be experienced in the absence of a permit quota). As can be readily noted by comparing the base case to Case B and Case C, values per trip are not very sensitive to basing model parameter estimates on the total potential demand. Values for Case B and Case C are only six to eight percent higher than the base case. A related finding is that the value per trip estimate is not very sensitive ($196 versus $200) to the range of predicted nonresident permit sales (26,500 versus 31,300).

Although not an appropriate estimate of the average value of current Montana elk hunting trips, it is of interest to note the average value of trips in the absence of a nonresident permit quota. Estimates are provided in Cases D and E. The latter use, respectively, the same model parameters as Cases B and C. The difference is that actual trips taken are based on what would be observed in the absence of a nonresident quota. The proportion of higher valued nonresident trips rises from the current 15 percent to 21 percent and 25 percent in Case D and E respectively. The corresponding value for the Gum and Martin method is $209 for Case D and $220 for Case E (Table 18). The conventional estimates based on predicted trips are $334 and $342 respectively.

The Case D and E values are higher than the base case because of two factors. One factor is that for any given trip, the value per trip is higher because of the effect of alternative model parameters on the shape of the estimated demand curve. (As was discussed in Section VI, when more nonresident trips are included in the sample, the estimate of how rapidly trips drop off with increased distance is reduced (the coefficient on round trip distance has a lower absolute value). The result of this is that the estimated value of any given trip is predicted to be higher.) A second factor in Cases D and E is that not only is any given trip more valuable, but there is also a greater proportion of the more valuable non-resident trips. The estimates in Cases D and E might be called potential market values since they show average values as if there was in fact no nonresident elk permit quota.

The basic conclusion of this analysis is that the average value per trip is not very sensitive to including all potential nonresident hunting trips in the sample. Because of this finding, the base case result may be used as a good, though somewhat conservative, estimate. One advantage of using the base case is that the conventional estimates (based on predicted trips) are meaningful and can be compared to the results of other studies.

Table 14 also provides some evidence on the sensitivity of

benefit estimates to specification of the price variable. Cases A through E are based on the RDTRDS1 price variable. An alternative definition (described in Section V) is RDTRDS2 where nonresident fixed costs per trip include the $300 permit fee. Cases C and F are comparable except that Case F is based on RDTRDS2. The relative values per trip are $200.44 and $220.83 respectively. Accordingly, benefits estimates vary by about 10 percent due to separate effect of the alternative price variable specification.

The overall effect of both the alternative price specification and the use of total potential nonresident trips in the data base (TRIPCP3) can be seen by comparing Case F and the base case. Case F is 20 percent higher than the latter. A limitation of Case F is that it is not strictly based on the survey data, but requires an inference regarding permit costs. However, the available data does support the inference, and it would appear appropriate to include the most complete estimate of trip costs possible. These findings provide additional evidence that the base case is somewhat conservative.

VIII. COMPARISON TO OTHER STUDIES

The results of this study can be briefly compared to several other elk hunting analysis. Sorg and Nelson (1985) undertook a TCM analysis of elk hunting in Idaho. Their travel cost analysis

was based on a sample of 1926 hunters (approximately three times the Montana data base). Sorg and Nelson's methodology differed somewhat from the current study in that a semi-log functional form was used. They reported a highly significant equation (R-square of .69) with trip prediction within 25 percent of actual. Sorg and Nelson's benefit estimates were based on numerical approximation on the second stage demand curve, and an upper limit of integration of 5000 miles. This limit is based on the furthest observed distance in their sample. The standard and reported cents/mile values used in their analysis were 13.5 and 31.3 cents per mile respectively. The latter are similar to the 13.4 and 42.2 values used in this analysis.

The Idaho TCM estimates are summarized in Table 15. Average consumer surplus per trip based on model predicted trips is $99.82 for reported travel costs.

For comparison purposes, this study's estimate for Montana based on the double log model and reported costs is also summarized in Table 15. The Montana estimate at $185 is about double the Idaho semi-log estimate. In interpreting this comparison, it should be recalled that Equation 7 is heteroscedastic and overpredicts trips. This is the reason for utilizing the Gum and Martin benefit estimation method in the Montana estimate. It is possible that the Idaho estimates are also influenced by heteroscedasticity. It is also not known whether Idaho also has

Table 15

Montana Elk Hunting
Net Economic Value Per Trip
Comparison to Other Studies

Method/Study	Value Per Trip (Study year dollars)
A) Travel Cost Method	
Idaho (1984)[1]	99.82
Montana (1985)[2]	184.56
B) Contingent Valuation Method	
Idaho (1983)[3]	51.84 (open-ended)
Idaho (1984)[3]	92.54 (iterative bid)
Idaho, Utah, Nevado, Wyoming (1982)[4]	36.37 (open-ended)
Montana (1986)[5]	116.60 (open-ended)
	280.22 (logit)

1 Sorg and Nelson (1985). At 31.3 cents/mile reported, semi-log model.

2 Current Study. At 42.2 cents/mile reported costs, double-log model.

3 Sorg and Nelson (1985)

4 Hansen (1977)

5 Loomis, Cooper and Allen (1988)

constraints on the number of nonresident and or resident permits. Given these limitations, comparative interpretations should be made with caution.

It should also be noted that the estimates summarized in Table 15 are for different years (as noted in the table) and are not corrected to remove the influence of overall levels of price inflation across years.

Sorg and Nelson also undertook a direct willingness to pay survey or contingent valuation method (CVM) analysis. (See Loomis, Cooper and Allen (1988) for a discussion of CVM.) For two different sample years, Idaho hunter mean willingness to pay is $51.84 (1983) and $92.54 (1984). These estimates may differ in part because of methodology: the 1983 estimate is based on an open-ended CVM while the 1984 is based on interative bidding.

A second elk hunting CVM estimate is referenced by Sorg (Hansen, 1977). The latter is an estimate for a region including Idaho, Utah, Nevada and Western Wyoming. Sorg reports an estimate from Hansen (corrected to 1982 dollars) of $36.37. Given the change in the overall level of prices between 1982 and 1985, Hansen's estimate in 1985 dollars would be about $41.

A final estimate is for Montana for the hunting season of 1986 (Loomis, Cooper and Allen, 1987). This study utilized two

different CVM methods (dichotomous choice and open-ended) on a large data base (about 3,000 observations). The open-ended estimate of net economic benefits per trip is $116.60. The dichotomous choice mean value is $280.22, based on a logit specification. This pattern of results, with open-ended CVM values much lower than dichotomous choice has been found in other studies. It appears that many respondents have difficulty answering open-ended value questions.

Taking the two Montana studies together, the travel cost model estimate based on reported cost ($185) lies between the open-ended and dichotomous choice CVM estimates ($117 and $280 respectively).

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APPENDIX A. SURVEY FORM

INTERVIEW DATE ____________

INTERVIEWER ____________

Did not hunt this past season ________

HUNTING SURVEY

For random trip# (1 die) ____,
if >6, roll again and add to 1st as needed

		HUNTING TRIP 1st	2nd	3rd	4th	5th	6th	7th	8th
1. Primary hunting area? (From Map)									
2. Was the primary purpose of your trip to hunt big game?	YES / NO								
3. Primary species you selected the area for?	ELK								
	DEER								
	ANTELOPE								
4. Number of game you killed?	ELK								
	DEER								
	ANTELOPE								
5. Type of weapon used?	FIREARM / ARCHERY								
6. Total number of days away from home	(DAYS)								
7. Total number of hours hunted.	(HOURS)								
8. One way distance to hunting area.	(MILES)								
9. Was this area the primary place you hunted? (If yes go to next question)	YES								
If no, how may areas did you hunt in? (Terminate and start next hunting trip)	NO								
10. How many years have you visited this area to hunt big game?	YEARS								
11. If you were unable to hunt in this area (due to emergency closure) would you have hunted this species at another area? If yes which one?	YES AREA								
	NO								
12. About how long did it take to travel from your home to ______? (This should start when they left home and end when they arrived at the hunting area)	DAYS								
	HRS.								
	MIN.								
13. Did you travel entirely by vehicle? YES ____ (If yes, fill in only 1st Mode section)	1st MODE TYPE								
	MILES								
	$SPENT								
NO ____ (If no, fill in as many Modes as necessary)	2nd MODE TYPE								
	MILES								
	$SPENT								
Would you estimate the miles you traveled and what your transportation costs were?	3rd MODE TYPE								
	MILES								
	$SPENT								
14. If you had not gone hunting, would you have been working?	YES / NO								
15. If yes, did this trip result in lost income?	YES / NO								
16. If yes, could you estimate about how much you lost by going hunting? (Ask only once)									

MODE TYPE

1. Compact (4 cyl)
2. Intermediate (6 cyl)
3. Full size (8 cyl)
4. 4 wheel drive
5. Recreational
6. Bus
7. Plane
8. Train
9. Motorcycle
10. Horseback
11. Walk

1. "First, about how many years have you been hunting?"
YEARS HUNTED ________

2. "What percentage of your hunting time was spent on foot or on horse back?"
TIME ________

3. "For hunting purposes, do you feel that the number of open roads in THIS AREA is: (Check One)
___ TOO FEW
___ ABOUT RIGHT
___ TOO MANY

4. "On average, how crowded did you feel this area was when you were hunting?" (Check One)
___ NOT AT ALL CROWDED
___ SOMEWHAT CROWDED
___ VERY CROWDED

5. "What do you perceive your chances of bagging a 4 point or better buck or 6 point or better bull elk are in this hunting area?"
Bull: _____Poor _____Fair _____Good _____Excellent
Buck: _____Poor _____Fair _____Good _____Excellent

6. "How many licensed hunters were in your vehicle?"
LICENSED HUNTERS ________

7. The next questions will help us to determine how much people spend on their Montana hunting trips. I'm going to list several things you may have spent money on specifically for this trip to ________________. Could you tell me how much you spent, if anything, on each item during the trip?

NOTE - Read each item, then record a dollar value next to it.

Total transportation costs (gas,oil,wear & tear) $__________
% at home ________
% spent in route ________
% near or at site ________

Lodging, such as hotels or campground fees? $__________
% spent in route ________
% near or at site ________

Food and beverages bought in stores? $__________
% spent in route ________
% near or at site ________
% at home ________

Food and beverages bought in resturants? $__________
% spent in route ________
% near or at site ________

Fees for guides or outfitters? $__________

Any other on site purchases such as hunting equipment, film, auto repairs, etc. $__________

8. "Was the trip to this area worth more than you paid?"
___ YES
___ NO

If yes, what is the maximum amount you would have been willing to spend to visit this hunting area rather than some other?
$__________

9. "How does hunting compare to other types of outdoor recreation you do?" (Check One)
___ FAVORITE
___ ONE OF FAVORITE
___ ONE OF MANY

10. "Could you estimate the current market value of the equipment you have purchased over the years primarily for hunting such as guns, wall tents, campers, etc.?
CURRENT VALUE IN HUNTING EQUIP. $__________

11. "How many children under 15 live in your household?"
CHILDREN ________

12. "How many years of education have you had?"
YEARS ________

NOTE: Elementary = 6 yrs.
High School = 12 yrs.
College Degree = 16 yrs
Master's Degree = 18 yrs
Ph.D or MD. = 20 yrs

13. "During this last fall, about how many hours a week did you normally work?" (Include time such as housework, volunteer work etc.) (Check One)
___ 01 - 10 HOURS
___ 11 - 20 HOURS
___ 21 - 30 HOURS
___ 31 - 40 HOURS
___ 41 - 50 HOURS
___ 51 - 60 HOURS
___ MORE THAN 60 HOURS.

14. "As I read the following age catagories, please indicate which one you are in." (Check One)
___ a. 12 - 15 ___ d. 30 - 39 ___ f. 50 - 61
___ b. 16 - 20 ___ e. 40 - 49 ___ g. 62 or older
___ c. 21 - 29

15. "I'm going to read a list of income categories. Could you please tell me which catagory your total household income before taxes in 1985 is in?"
_____ a. 0 - 5,000 _____ f. 25,000 - 30,000
_____ b. 5,000 - 10,000 _____ g. 30,000 - 40,000
_____ c. 10,000 - 15,000 _____ h. 40,000 - 50,000
_____ d. 15,000 - 20,000 _____ i. 50,000 - 75,000
_____ e. 20,000 - 25,000 _____ j. MORE THAN 75,000 (please specify to nearest $10,000 dollar)

16. "This is the last question. Is there anything you would like to tell us about hunting in Montana?"

____

____

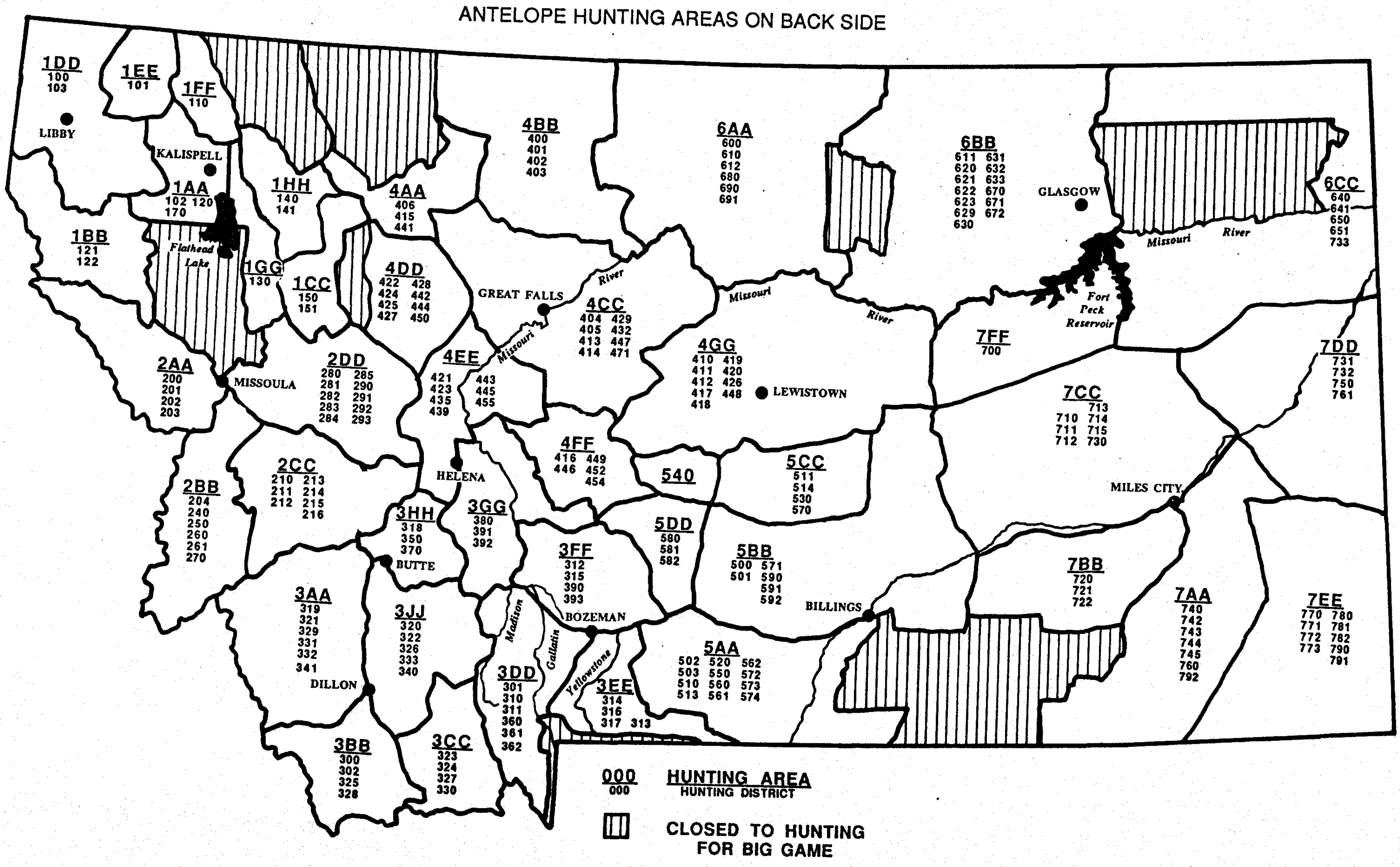
____

____

APPENDIX B. MAP OF HUNTING AREAS

ELK AND DEER HUNTING AREAS

ANTELOPE HUNTING AREAS ON BACK SIDE



APPENDIX C. BENEFIT ESTIMATES BASED ON PREDICTED TRIPS

This appendix provides a summary of net economic values for Montana elk hunting when the intercept term (number of trips) in the second stage TCM demand curve is based on predicted trips. Section II above provides a discussion of this methodological choice.

Consumer surplus per trip based on equations 7 and 8 and predicted trips is shown in Tables C1 and C2. The site average per trip based on the standard cost parameter (13.4 cents per mile) is $123.55 and for reported trip costs (42.2 cents per mile)is $325.53. The values per day based on the site specific average days hunting per trip are $42.01 and $110.61 for the standard and reported cost estimates respectively.

The averages shown Tables C1 and C2 are simply averages across sites. In other words, each site counts equally in the average independent of how many hunters visit that site. In the following section total site values are derived based on the amount of hunting pressure each site receives. The total site values can then be used to estimate state average values that are weighted by the hunting pressure at each site.

Based on the standard cost approach, the total recreational value

of Montana elk hunting sites is $23.7 million per year (Table C3). The corresponding estimate based on reported cost is $62.2 million (Table C4).

State average (pressure-weighted average) values for elk hunting per day can be derived from the totals in Tables C3 and C4. For standard cost the value per day is $41.36 and the value per trip (based on the sample average days per trip of 2.81) is $116.22. The corresponding estimates for the reported cost basis are $108.74 and $305.56 per day and per trip respectively.

The value of a Forest Service Recreation Visitor Day (based on our sample average of 6.299 hours of hunting per day) is $78.79 for standard cost and $207.16 for reported cost.

The benefit estimates described here are contrasted with the results of the Gum and Martin approach in Section VII.C and Table 12 above.

Table C1

Montana Elk Hunting
Net Economic Value Per Trip
(Standard Cost)

Area Number	Hunting Area	Value Per Trip	Avg Days Per Trip	Value Per Day	Observations
101	Kalispell	223.86	4.53	49.41	29
102	Libby	21.55	1.59	13.51	31
211	Superior	169.70	3.26	52.05	14
222	Hamilton	84.45	2.02	41.90	17
233	Flint Creek	75.92	1.67	45.60	25
244	Ovando	79.48	3.15	25.23	35
311	Pioneers	157.60	2.77	56.82	34
333	Gravelly	168.48	3.16	53.29	19
344	Madison	211.87	3.28	64.63	41
355	Gardiner	307.36	2.66	115.64	43
366	Bridger	10.81	1.29	8.39	24
377	Townsend	160.86	2.30	69.86	38
388	Butte	12.79	1.60	7.99	13
399	Tobacco Root	48.94	3.58	13.66	24
401	Augusta	181.72	2.66	68.29	23
402	Great Falls	125.17	3.57	35.06	18
455	Wolf Creek	9.77	1.91	5.12	22
466	Little Belts	115.51	3.36	34.48	18
477	Lewistown	319.22	3.43	93.12	19
501	Billings	53.09	3.47	15.30	14
601	Eastern Mont	56.48	4.40	12.84	19
Site Averages		123.55	2.84	42.01	

Source: Equation 8

Table C2

Montana Elk Hunting
Net Economic Value Per Trip
(Reported Cost)

Area Number	Hunting Area	Value Per Trip	Avg Days Per Trip	Value Per Day	Observations
101	Kalispell	552.46	4.53	121.94	29
102	Libby	55.02	1.59	34.50	31
211	Superior	482.57	3.26	148.02	14
222	Hamilton	225.09	2.02	111.66	17
233	Flint Creek	211.80	1.67	127.20	25
244	Ovando	219.29	3.15	69.62	35
311	Pioneers	405.52	2.77	146.20	34
333	Gravelly	471.80	3.16	149.23	19
344	Madison	528.49	3.28	161.21	41
355	Gardiner	774.92	2.66	291.54	43
366	Bridger	24.65	1.29	19.13	24
377	Townsend	408.30	2.30	177.33	38
388	Butte	35.16	1.60	21.97	13
399	Tobacco Root	124.10	3.58	34.63	24
401	Augusta	477.06	2.66	179.29	23
402	Great Falls	349.69	3.57	97.94	18
455	Wolf Creek	22.13	1.91	11.61	22
466	Little Belts	334.45	3.36	99.56	18
477	Lewistown	831.72	3.43	242.63	19
501	Billings	146.00	3.47	42.07	14
601	Eastern Mont	155.91	4.40	35.45	19
Site Averages		325.53	2.84	110.60	

Source: Equation 7

Table C3

Montana Elk Hunting
Total Recreation Value of Sites
(Standard Cost)

Area Number	Hunting Area	Value Per Day	Sample Days	Hunting Pressure	Site Value 000$
101	Kalispell	49.41	226.74	38271	1891
102	Libby	13.51	126.00	70863	951
211	Superior	52.05	132.29	34412	1791
222	Hamilton	41.90	112.35	51601	2162
233	Flint Creek	45.60	99.21	29906	1364
244	Ovando	25.23	175.57	52070	1314
311	Pioneers	56.82	257.66	39824	2263
333	Gravelly	53.29	107.99	21830	1163
344	Madison	64.63	231.02	25462	1646
355	Gardiner	115.64	201.30	24090	2786
366	Gridger	8.39	67.00	15500	130
377	Townsend	69.86	157.29	26370	1842
388	Butte	7.99	40.00	15082	121
399	Tobacco Root	13.66	180.28	20735	283
401	Augusta	68.29	114.83	22326	1525
402	Great Falls	35.06	113.87	13747	472
455	Wolf Creek	5.12	82.00	28020	144
466	Little Belts	34.38	99.36	19199	660
477	Lewistown	93.12	139.10	10345	963
501	Billings	15.30	59.00	12930	198
601	Eastern Mont	12.84	121.98	104	1
State Total				572414	23677

Source: Equation 8

Table C4

Montana Elk Hunting
Total Recreational Value of Sites
(Reported Cost)

Area Number	Hunting Area	Value Per Day	Sample Days	Hunting Pressure	Site Value 000$
101	Kalispell	121.94	226.74	38271	4667
102	Libby	34.50	126.00	70863	2445
211	Superior	148.02	132.29	34412	5094
222	Hamilton	111.66	112.35	51601	5762
233	Flint Creek	127.20	99.21	29906	3804
244	Ovando	69.62	175.57	52070	3625
311	Pioneers	146.20	257.66	39824	5822
333	Gravelly	149.23	107.99	21830	3258
344	Madison	161.21	231.02	25462	4105
355	Gardiner	291.54	201.30	24090	7023
366	Bridger	19.13	67.00	15500	297
377	Townsend	177.33	157.29	26370	4676
388	Butte	21.97	40.00	15082	331
399	Tobacco Root	34.63	180.28	20735	718
401	Augusta	179.29	114.83	22326	4003
402	Great Falls	97.94	113.87	13474	3120
455	Wolf Creek	11.61	82.00	28020	325
466	Little Belts	99.56	99.36	19199	1911
477	Lewistown	242.63	139.10	10345	2510
501	Billings	42.07	59.00	12930	544
601	Eastern Mont	35.45	121.98	104	4
State Total				572414	62244

Source: Equation 7